

OPPORTUNITIES FOR ADVANCING ANTERIOR CRUCIATE LIGAMENT REHABILITATION WITH SINGLE LEGGED CYCLING AND STANDARDIZED PERTURBATIONS

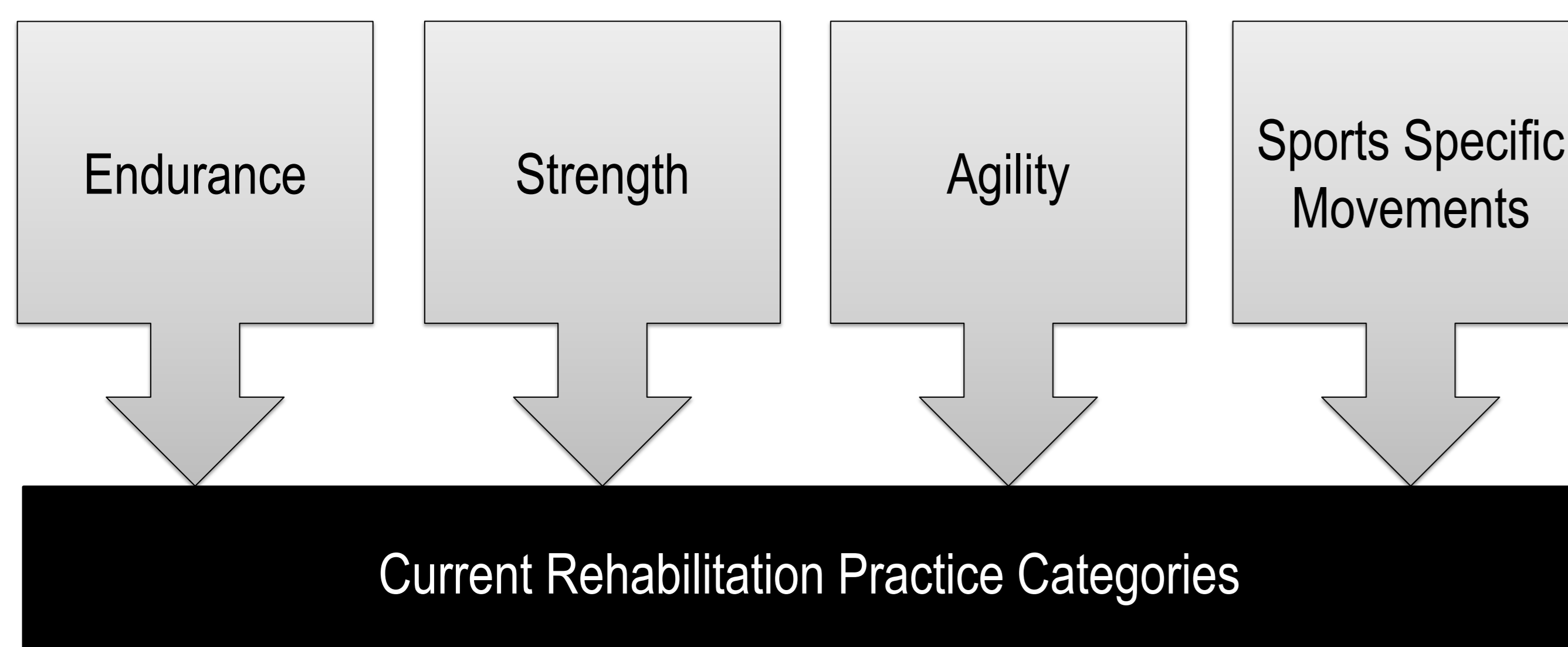
Maggie Grisell: Collaboration with Dr. Randolph Hutchison & Dr. Andrea Tartaro

I. BACKGROUND: The Anterior Cruciate Ligament

- The knee is constructed of four main ligaments (a) that keep the knee in place functionally and restrain it from bending too far in one direction
- The anterior cruciate ligament pulls the knee forward to keep it in the meniscus
 - The meniscus is cartilage located between the tibia and the femur and acts as a shock absorber and weight distributor for the knee
- ACL tears result because of valgus (outward bending of the knee) collapse, specifically when the “leg (thigh) falls in adduction and internal rotation, while the knee (tibia) moves into a position of abduction as the ankle and foot move into eversion during weight-bearing motions” (c)
 - Usually occurs during the cutting movement (b) so frequently seen in highly agile sports

II. BACKGROUND: Cycling as Rehabilitation

- **Advantages of Cycling:** provides a low-impact, non-weight bearing, cardio-vascular, closed-chain exercise; can be easily manipulated to target varying muscle groups
 - Extremely low strain on the ACL
 - Useful for endurance training and strength training



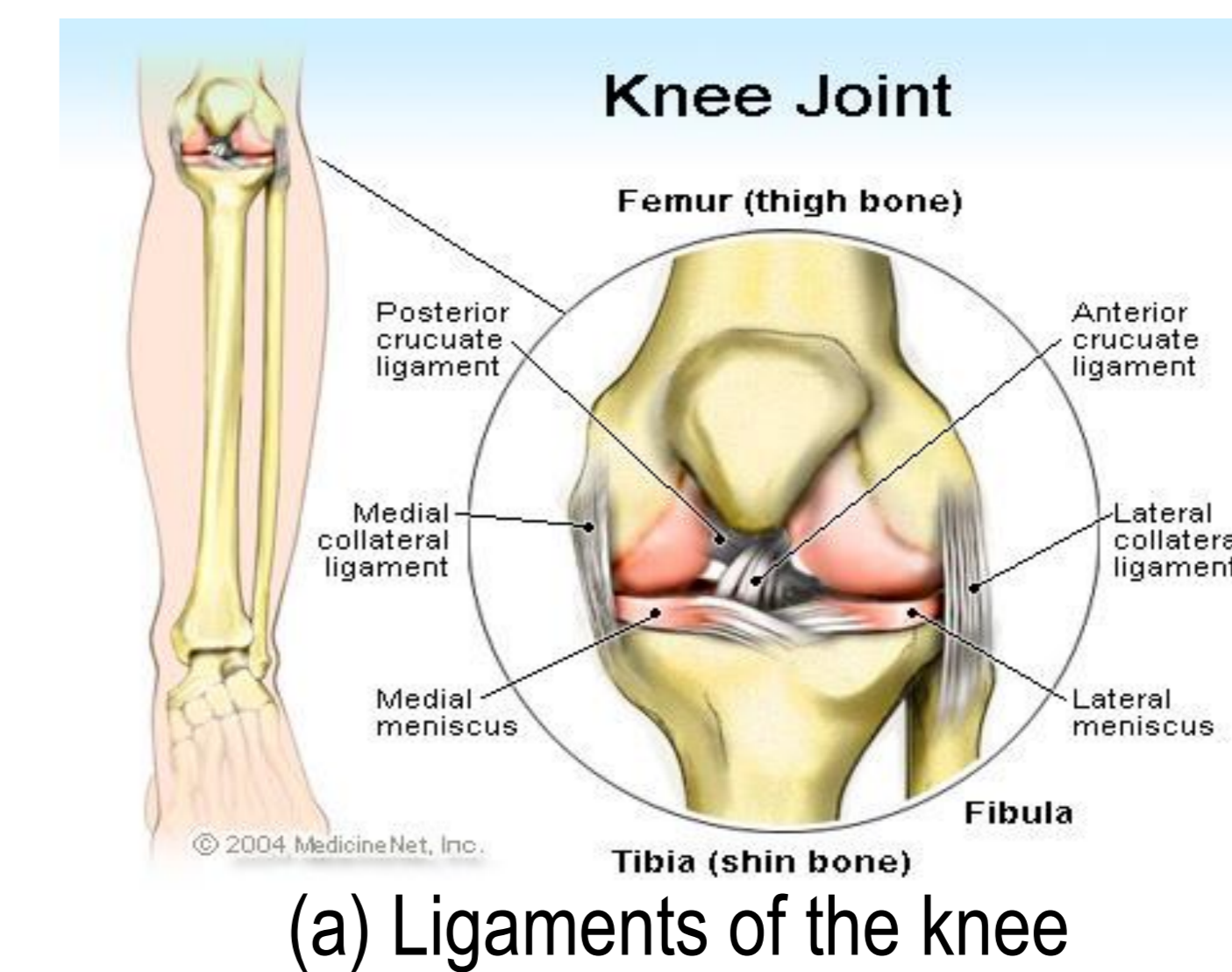
III. LIMITATIONS OF CURRENT PRACTICE

1. Extreme postoperative loss of muscle mass in quadriceps femoris

- Strength training may actually be more important to restore than cardiovascular endurance or agility
- Difficult to rebuild because of compensation by the uninjured leg and within the injured leg itself
- Thus, a huge opportunity remains for a closed chain and ACL-sensitive method that would specifically activate the quadriceps for the injured leg alone
- A cycling machine that instigates single-legged pedaling could be the answer. The two-legged motion could remain, but if the power came only from the injured leg, then the compensation from the other leg would be muted (creating a “master/slave” experience)

2. Perturbation Training: a type of neuromuscular training that aids in stabilization through muscular contractions (d)

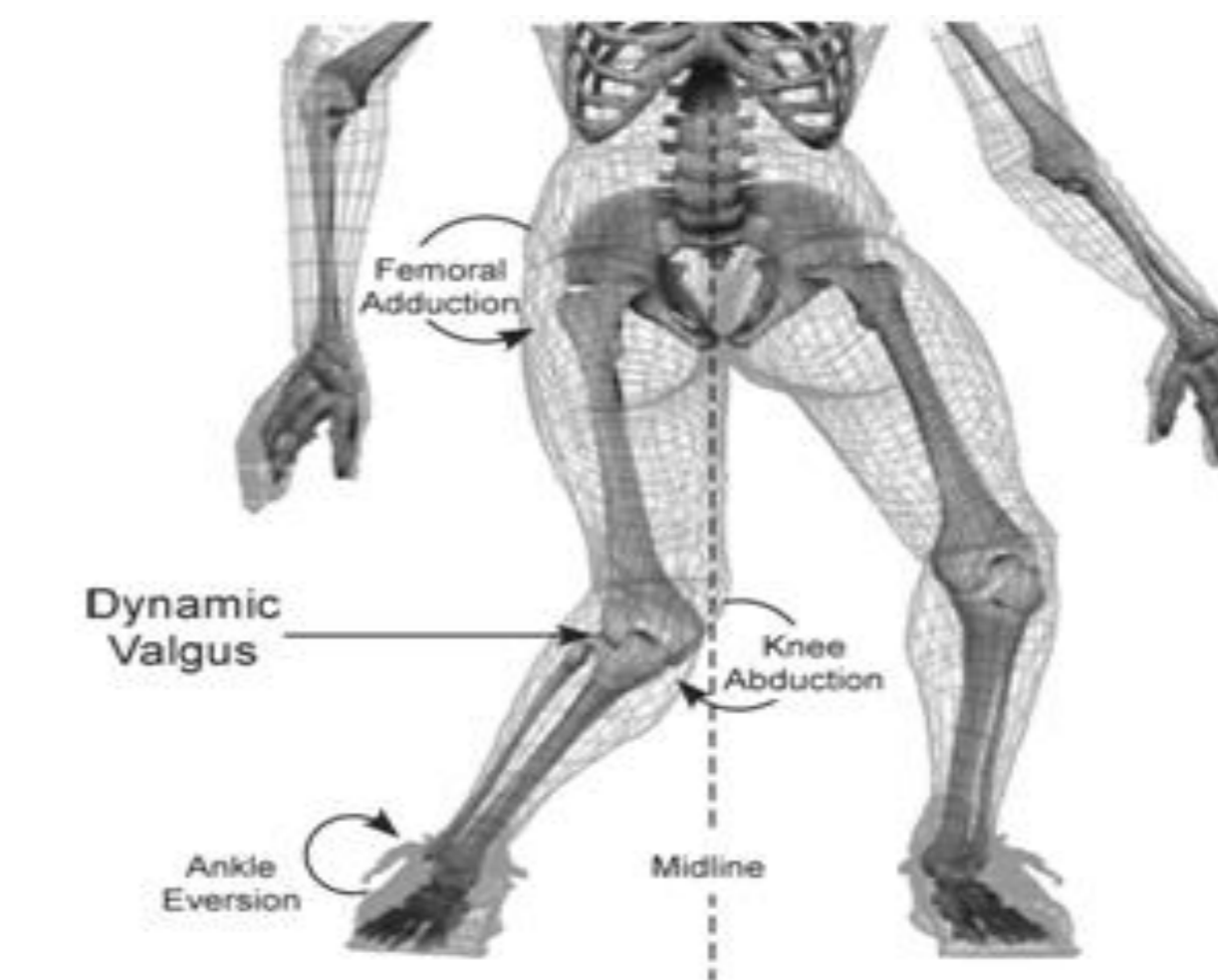
- A physician applies unpredictable and varying forces to an unstable surface on which the patient is standing
- Manual perturbations are imprecise and hard to measure
- An interface could be created on a cycling machine that provides a “slip” where, during pedaling, there is a random and unpredictable change in resistance
- The same neuromuscular pathways would be activated
- The frequency and severity of the slip could be manipulated in a study in order to determine how much force and in which way is most effective to improve anterior cruciate ligament rehabilitation



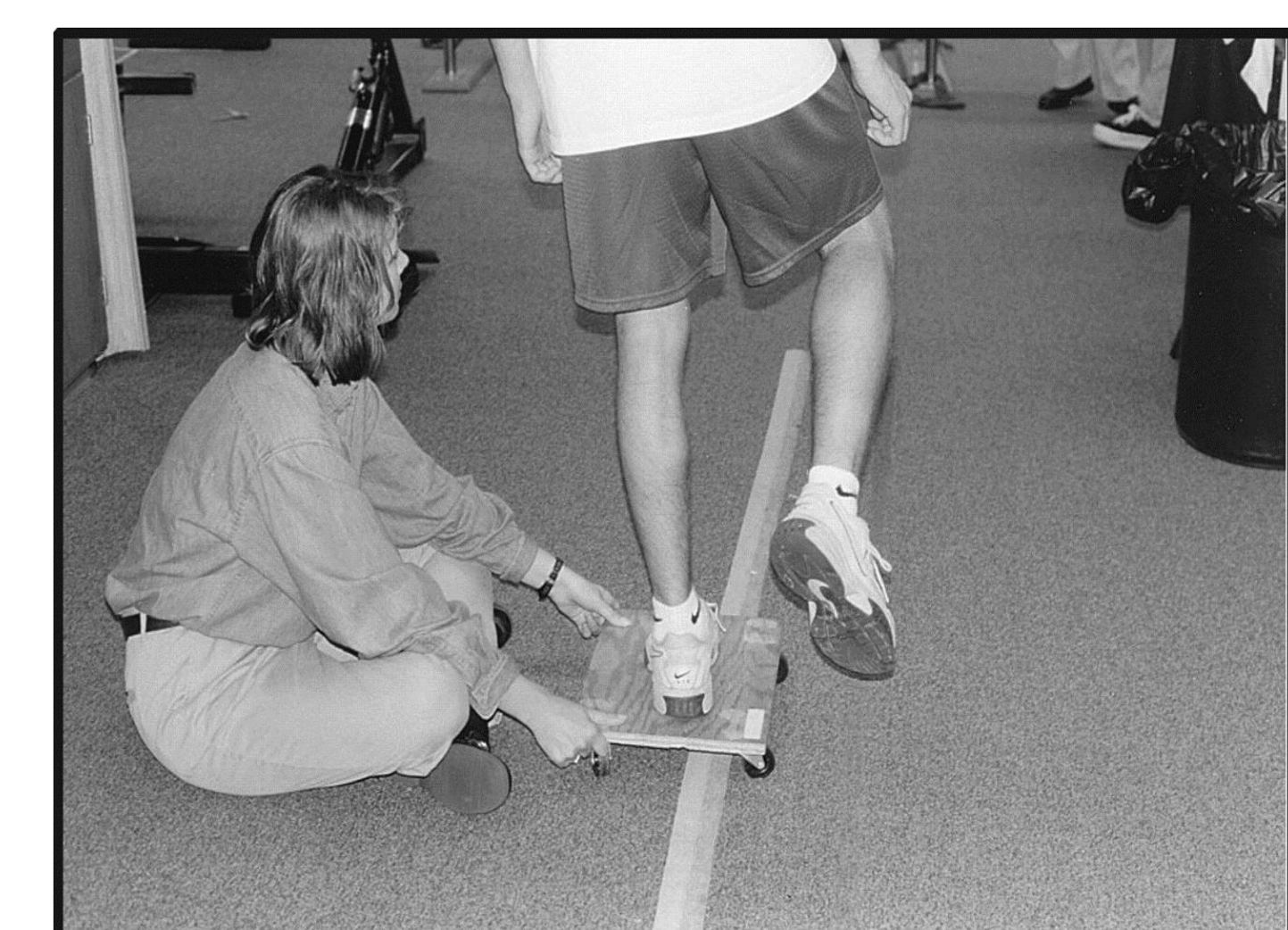
(a) Ligaments of the knee



(b) The common cutting movement



(c) Movement for ACL tear



(d) Current Perturbation Training Technique

IV. FUTURE STUDIES

- Single Legged Cycling with ACL rehabilitation
- Standardized Perturbations with ACL rehabilitation
- A programmed ergometer, such as the Tilt Cycle, could perform such studies

V. REFERENCES

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